Claims

What is claimed is:

1. A radiation sensor comprising:

   - a microplatform including a crystalline semiconductor pyro-optical film tethered above and thermally isolated from a substrate;
   - a first source of low level radiation incident upon the microplatform and partially absorbed therein causing a first incremental heating of said film;
   - a second source of radiation comprised of a carrier beam incident on said pyro-optical film and exiting by reflection from or transmission through said film;
   - the intensity of the exiting carrier beam modulated by the temperature of said pyro-optical film; and
   - a detector monitoring the intensity of the photonic carrier beam exiting the microplatform thereby providing a means of monitoring the intensity of the first source.

2. The radiation sensor of claim 1 formed using a bonded sandwich of semiconductor-insulator-substrate as the starting material for manufacture.

3. The radiation sensor of claim 1 with an electrical means of enhancing the first incremental heating of said film by thermal feedback.

4. The radiation sensor of claim 1 with a photonic means of enhancing the first incremental heating of said film by thermal feedback

5. The radiation sensor of claim 3 with a resistive heater element integral to the microplatform and powered from a fixed amplitude source to increase the temperature to a quiescent level above that of the substrate where the first incremental heating causes a change in the electrical resistance of said heater and thereby a second incremental heating thereby providing a total incremental heating in excess of the first incremental heating.

6. The radiation sensor of claim 5 where the heater element exhibits a negative temperature coefficient of resistance and is powered from a voltage source or where the heater element exhibits a positive temperature coefficient of resistance and is powered from an electrical current source.

7. The radiation sensor of claim 4 where the absorption of said second source in the pyro-optical film increases with temperature and where the introduction of said first incremental heating causes the absorption of the second source to increase further causing a second incremental heating beyond that which would obtain if the first source of radiation were applied alone, and where thereby a means of optical gain is implemented.

8. The radiation sensor of claim 2 where the crystalline semiconductor pyro-optical film includes but is not limited to silicon, germanium, an alloy of silicon and germanium, gallium arsenide, or indium arsenide having an optical absorption or reflectivity

characteristic which changes with temperature in the range of the wavelength range of the second radiation source.

9. The radiation sensor of claim 1 where the first and second sources each consist of one or more separate sources of radiation.

10. The radiation sensor of claim 1 where the means for achieving thermal isolation of the microplatform from said substrate includes operation in a vacuum and use of low thermal conductivity tetherbeams.

11. The structure of claim 1 where the substrate is a material transparent to the carrier beam including silicon dioxide.

12. The sensor of claim 1 where the response of the detector is synchronously gated during time windows of each amplitude modulation cycle of the second source to integrate the exiting photonic beam intensity during a first time window to define a reference level and separately during a second time window to define a biased level; with the second source comprised of different wavelengths during the first and second time windows; and with a detector readout which provides an unbiased level as the difference signal between the biased level and the reference level.

13. The radiation sensor of claim 1 where the detector is formed within said substrate comprising silicon or other semiconductor material adjacent to the overlying microplatform and positioned to receive radiation from the second source exiting the pyro-optical film.

14. The radiation sensor of claim 1 where the low level radiation incident on and partially absorbed in the microplatform is infrared radiation or millimeter wavelength radiation.

15. The radiation sensor of claim 1 where the low level radiation source incident on and partially absorbed in the microplatform is a radiation-emitting chemical reaction or biological process including chemiluminescence and bioluminescence.

16. The radiation sensor of claim 1 where the second radiation source is an ultraviolet, visible, or near infrared light source comprised of a light emitting diode, incandescent source, or a laser source emitting in the wavelength window modulated by the pyro-optical film and matched to the spectral sensitivity range of the detector.

17. The radiation sensor of claim 1 where the low level and high level sources of ra9. The radiation sensor of claim 1 configured as an array of microplatform pixels and optically aligned to a detector comprised of a charge-coupled diode CCD or CMOS imager array with signal conditioning circuitry providing an output signal formatted for driving external image displays or for buffering into external databases.

18. The radiation sensor of claim 1 with the low level radiation imaged onto the plane of an array of microplatforms and with the second source of radiation collimated or focussed such that the thermal image on said array is transferred to an array detector consisting of a charge-coupled diode CCD or CMOS imaging plane further comprising an imaging radiation sensor.

19. The sensor of claim 1 where the second radiation source, the pyro-optical film, and the detector are each comprised of silicon.

20. A method for producing an image of a scene using a thermal imaging system having a plurality of thermal sensors with elements sensitive to low level radiation mounted on or adjacent to an integrated circuit photonic detector comprising means of:

- thermally isolating the sensitive element within each thermal sensor from the integrated circuit substrate to form an image representative of the low level radiation;
- a single crystal pyro-optical film contained within each thermal sensor illuminated by a second source serving as a carrier beam;
- a means of directing incident low level radiation from the scene onto the infrared sensitive elements to form a thermal image;
- said carrier beam amplitude modulated by the temperature of the thermal sensor;
- means of projecting the second source of radiation onto the thermal sensors and exiting to the adjacent surface of the integrated circuit detector;
- means of providing photo-thermal or electro-thermal enhancement of the heating effect from the low level radiation; and
- said detector for the second source radiation including an array of photosensors contained within said integrated circuit to provide a signal representative of the thermal image.

21. The thermal imaging system of claim 20 where the pyro-optical elements are formed from a bonded sandwich of semiconductor-insulator-substrate as the starting material for manufacture.

References Cited

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